Building a Regional Market

California Desert Air Working Group Conference

Las Vegas, NV

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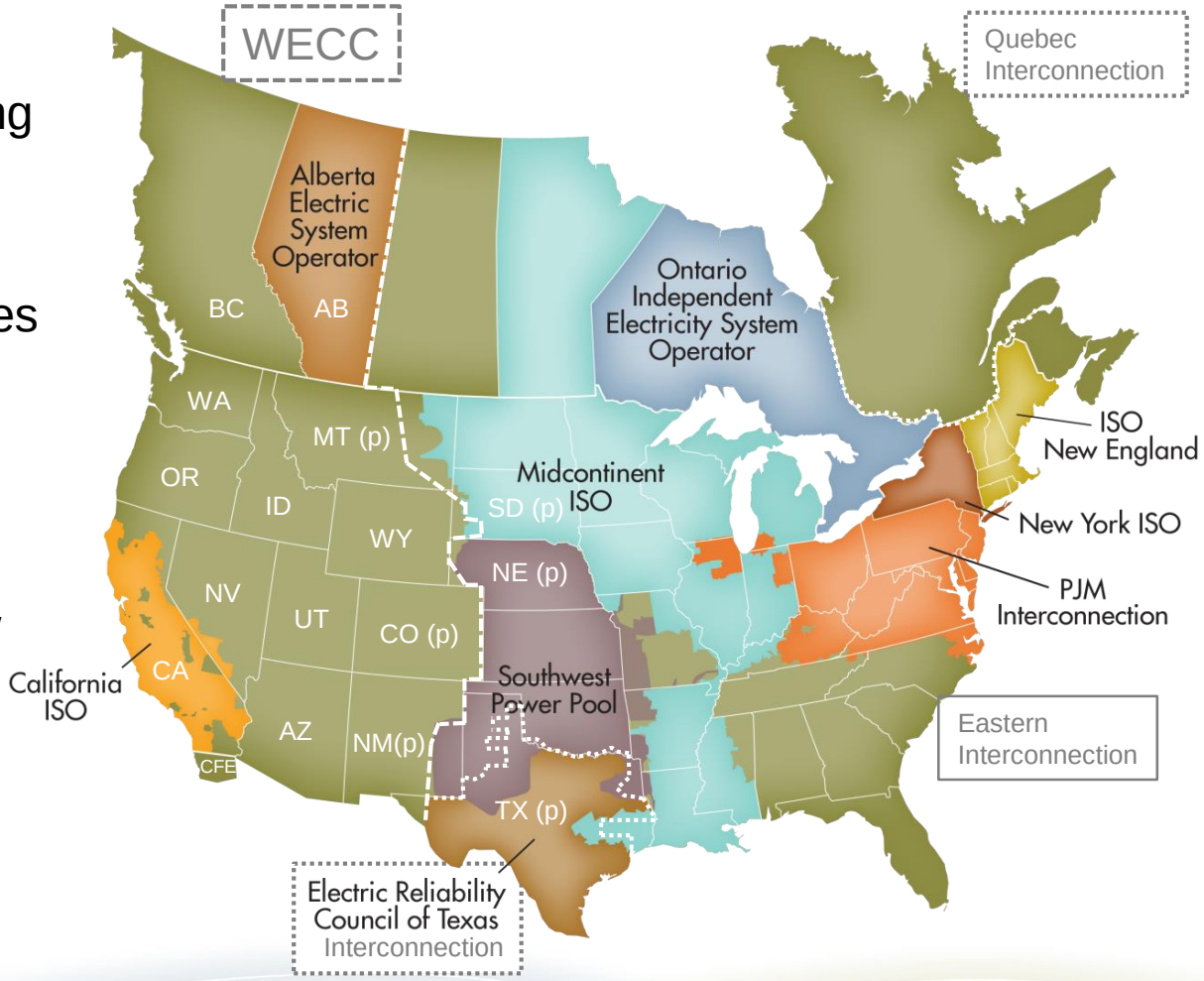
California ISO

- Nonprofit public benefit corporation
- Part of Western Electricity Coordinating Council: 14 states, British Columbia, Alberta and parts of Mexico
- 71,000 MW of installed capacity
- 50,270 MW record peak demand (July 24, 2006)
- 26,014 miles of transmission lines
- ISO is regulated by FERC, which has jurisdiction over transmission lines that cross state borders.

Two-thirds of the United States is served by independent system operators (ISO/RTOs)

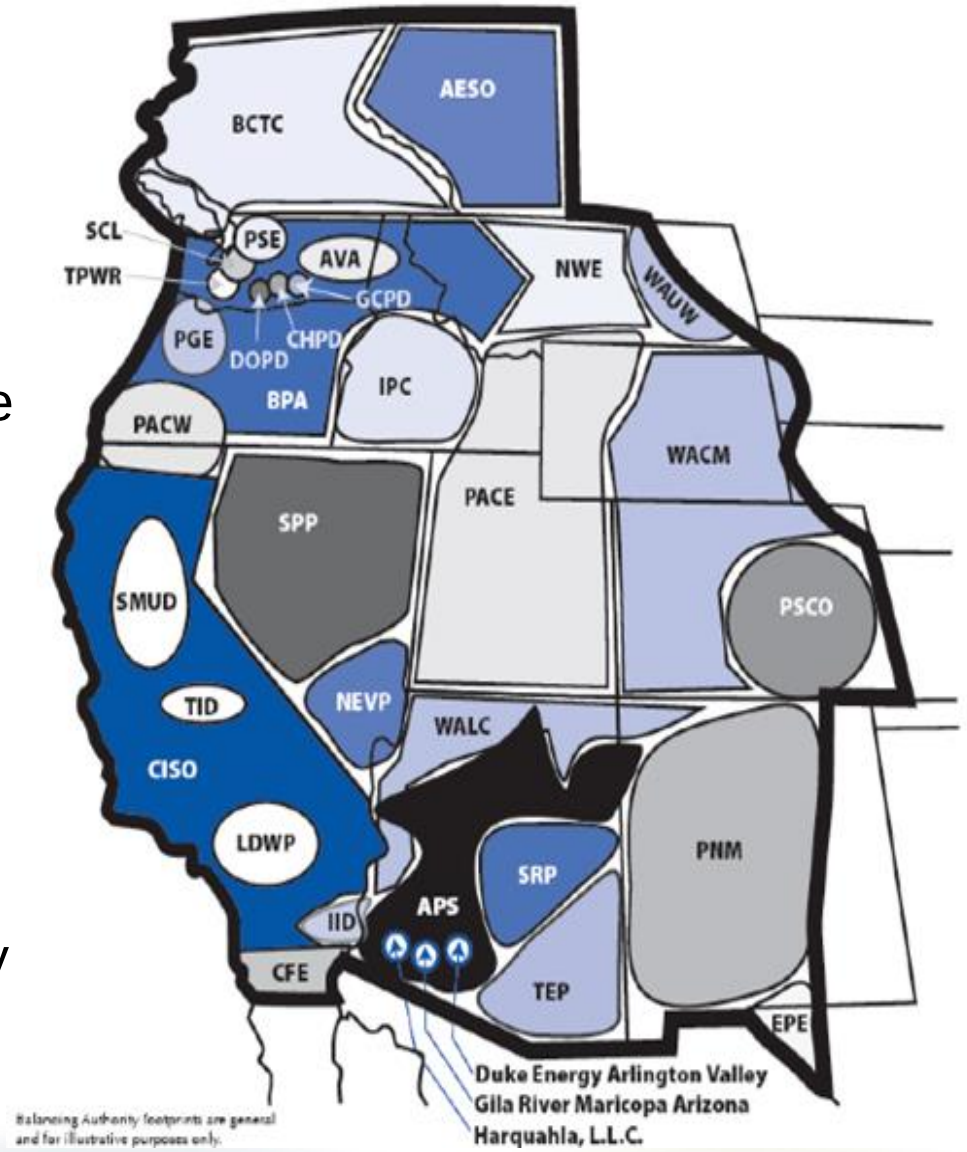
Western Electricity Coordinating Council (WECC):

- 38 of 76 balancing authorities in North America are in the WECC
- Serves approximately 82.2 million people
- Total capacity: 275,400 MW



The western grid

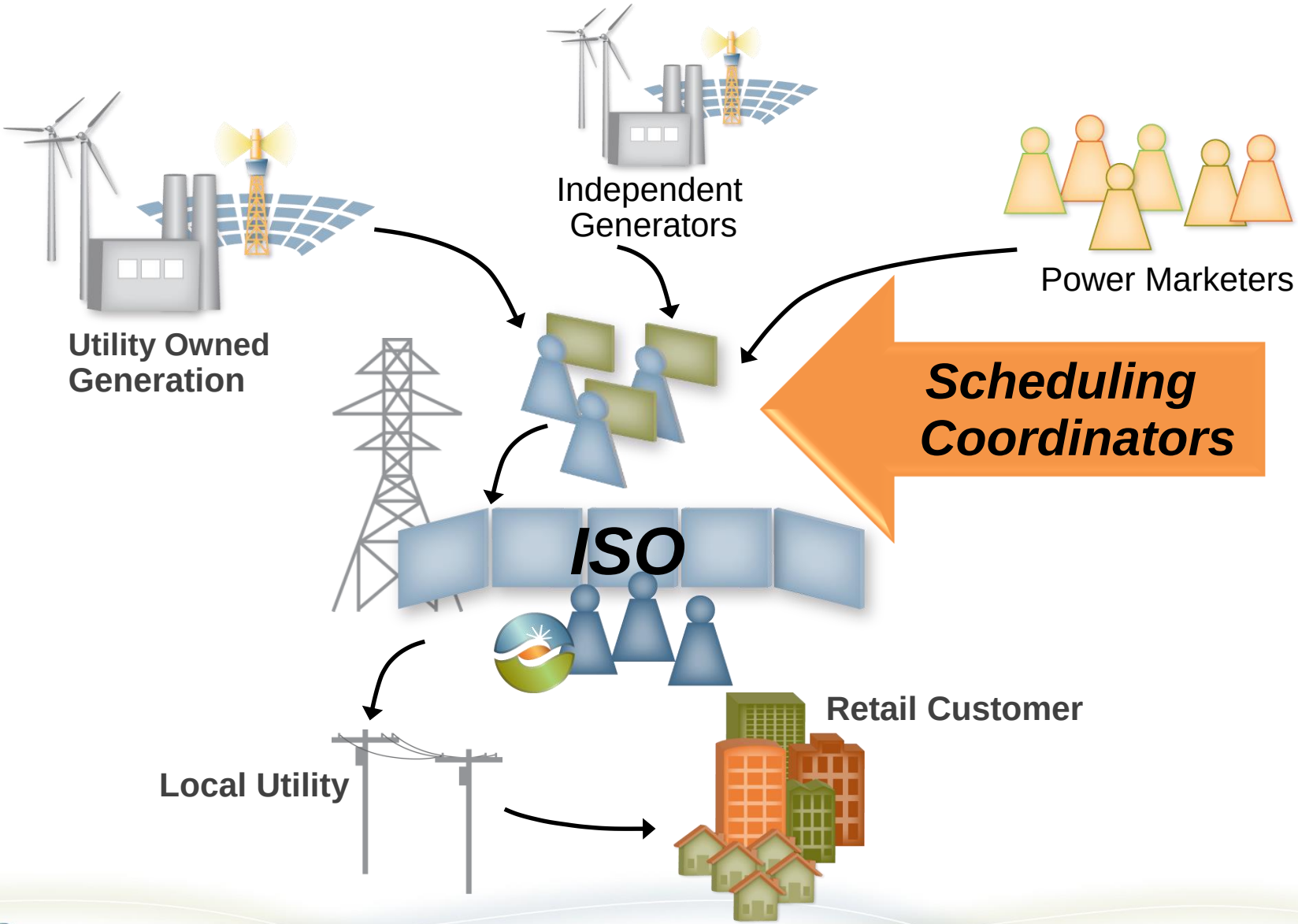
- The ISO is the largest of about 38 balancing authorities in the Western Interconnection, handling an estimated 35 percent of the electric load in the West.
- A balancing authority is responsible for operating a transmission control area.
- It matches generation with load and maintains electric frequency of the grid.



Key Functions of an ISO

- Reliably operate the grid
- Operate markets for energy and reserves
- Provides open transmission access and resource scheduling
- Plan future grid infrastructure needs
- Manage new generation interconnections

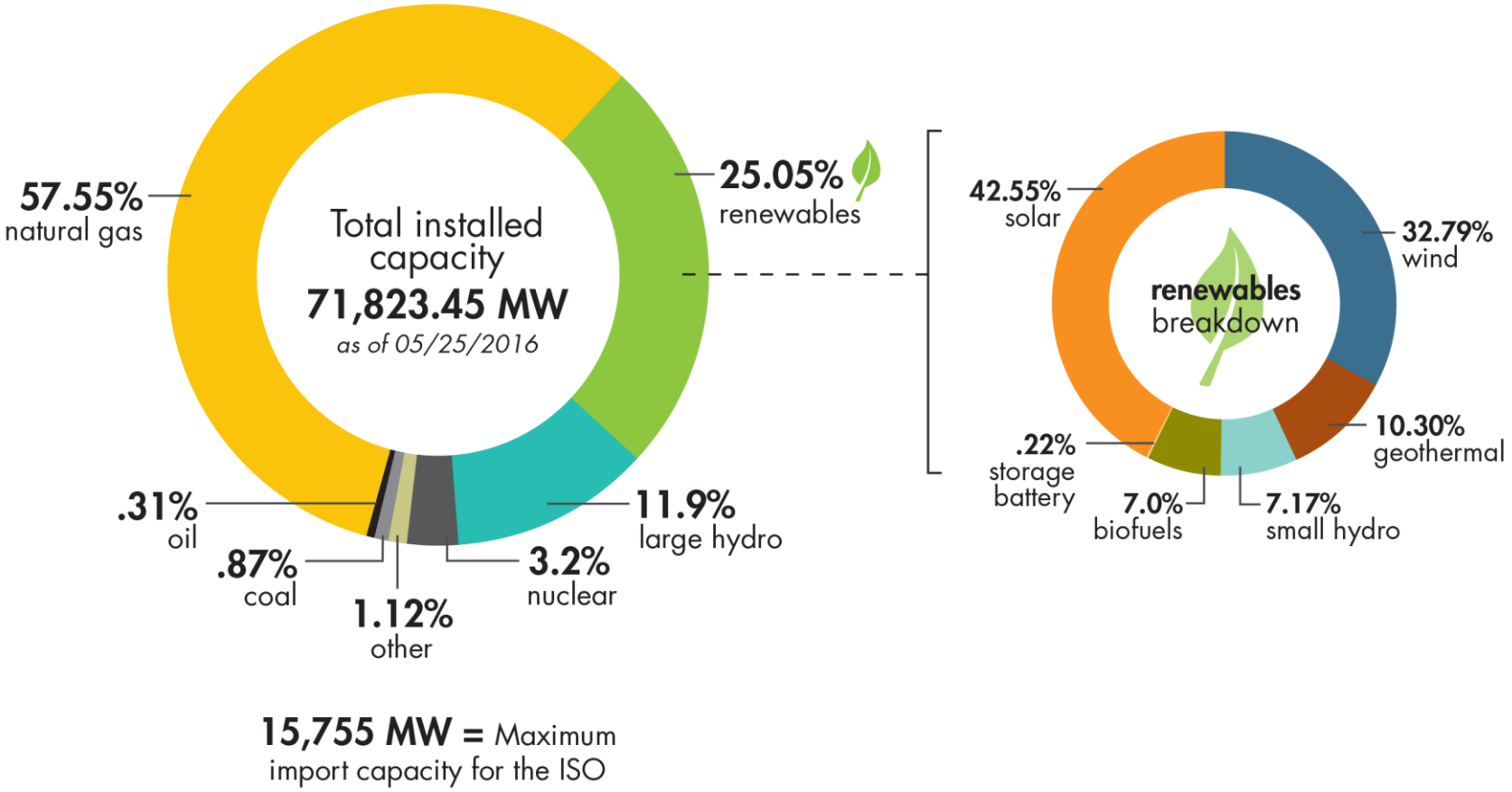
How the ISO fits in…



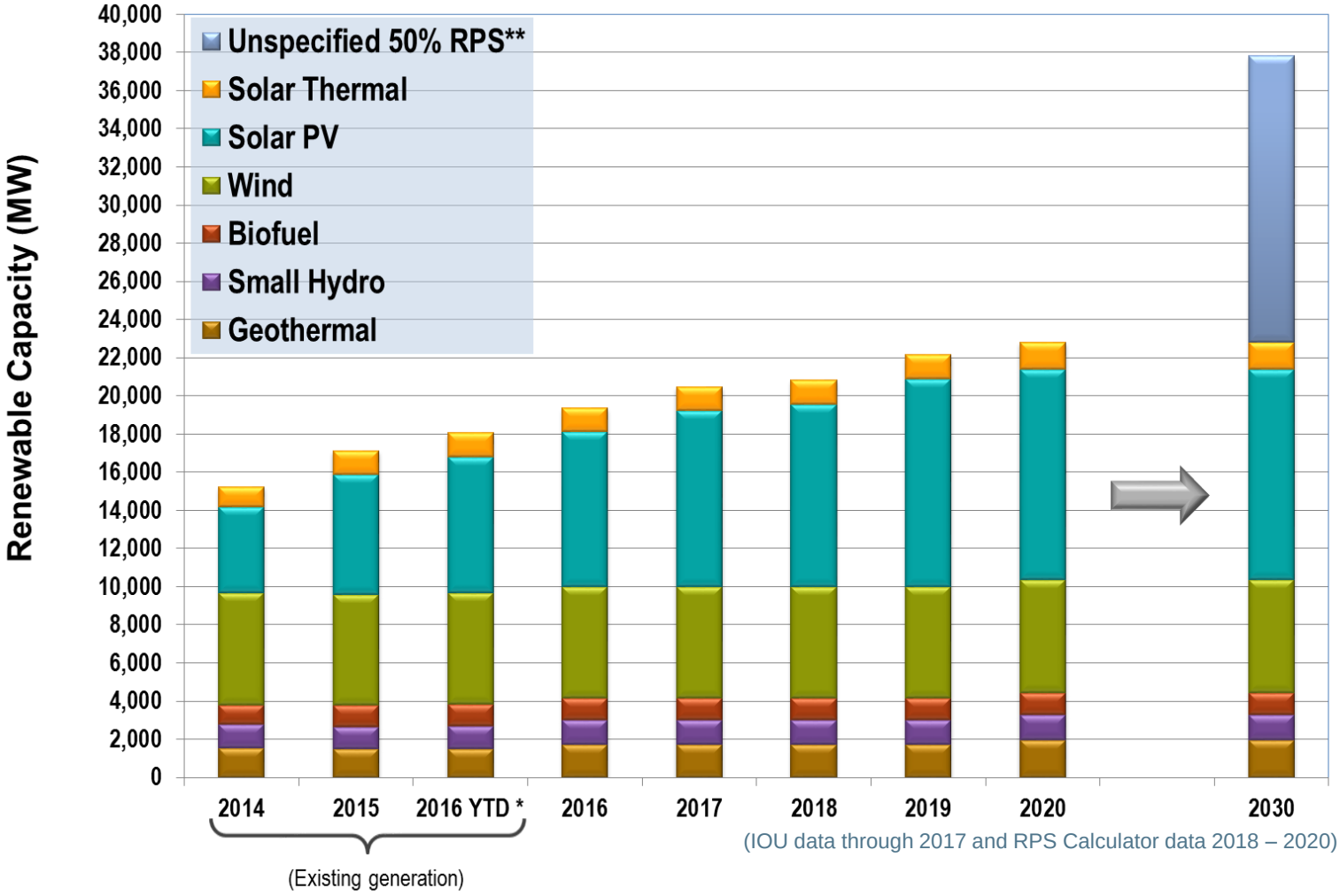
California energy and environmental policies drive renewable integration and transmission needs

- 2020 Policies
  - Greenhouse gas reductions to 1990 levels
  - 33% of load served by renewable generation
  - 12,000 MW of distributed generation
  - Ban on use of once-through cooling in coastal power plants
- 2030 Policy Goals
  - 50% of load served by renewable generation
  - Double energy efficiency existing buildings
  - Greenhouse gas reductions to 40% below 1990 levels

Resource mix



5,000 MW of additional transmission-connected renewables by 2020 (predominately Solar PV)



*All online resources that are not in test mode are included in the 2016 YTD amounts, including those yet to achieve full commercial operation.
**Approximate

Power industry transformation

Wind

- Unpredictable Output
- 4769 MW Peak – April 12, 2014

Solar Thermal / Photo Voltaic

- Semi – Predictable Output
- 8545 MW Peak – September 14, 2016

Roof Top Solar

- Semi – Predictable Output
- Behind the meter – Residential
- 3500 MW Estimated Capacity

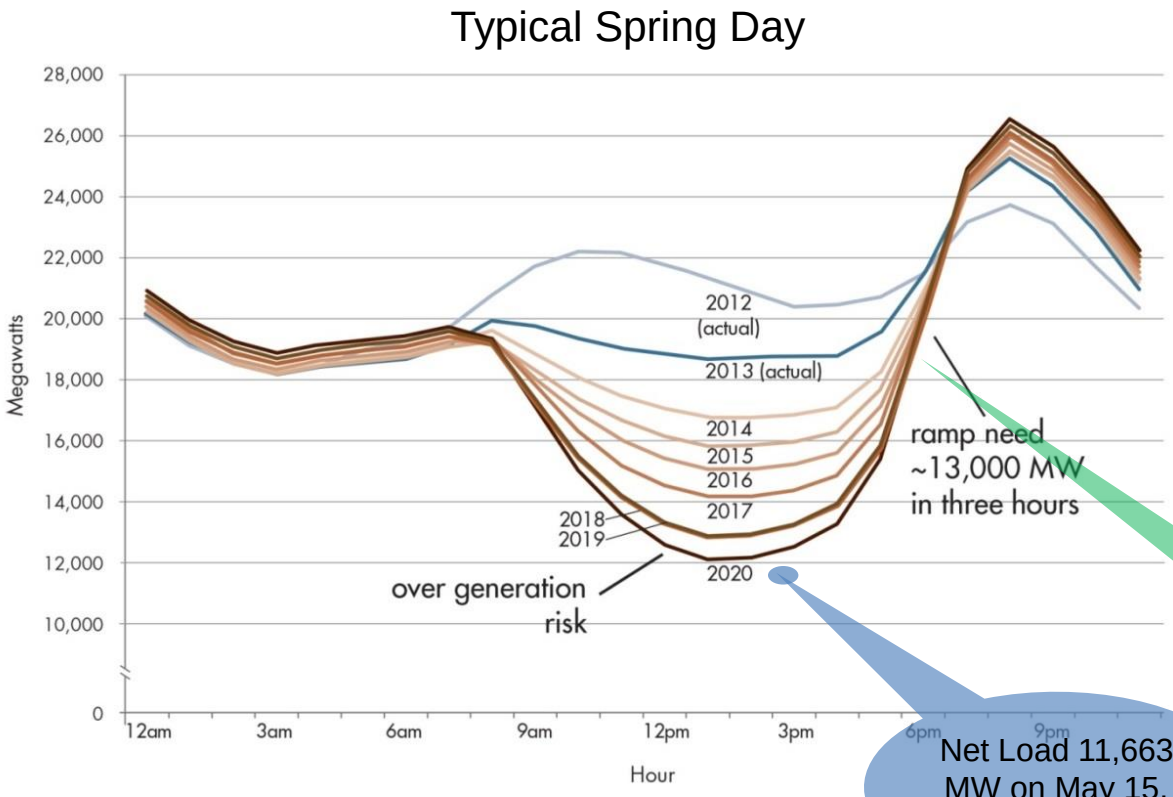
Main Drivers:

- ✓ California RPS
- ✓ GHG reduction
- ✓ Once-through-cooled plants retirement

Goals:

- ✓ Higher expectation of reliability
- ✓ Higher expectation of security
- ✓ Smart Grid
- ✓ Situational awareness through Visualization

Original estimate of net-load as more renewables are integrated into the grid

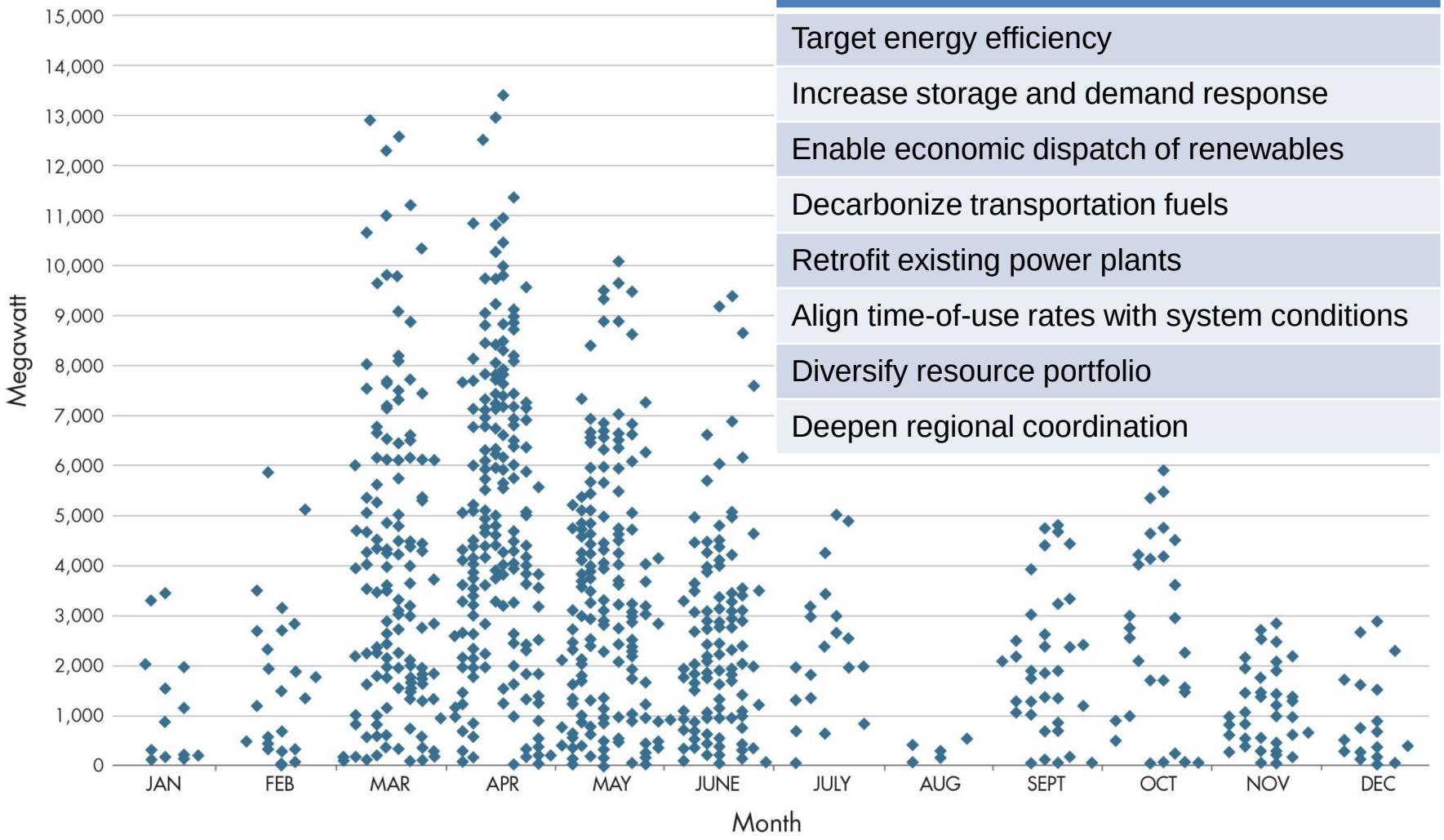


- ISO has already seen the need to curtail generation
- Oversupply may lead to curtailment because of dispatch limitations on some resources, such as
  - geothermal
  - nuclear
  - small hydro
  - combined heat and power
- Operational requirements include
  - minimum gas necessary to provide ramping
  - necessary ancillary services
  - load following

Net Load 11,663 MW on May 15, 2016

Actual 3-hour ramp 10,892 MW on February 1, 2016

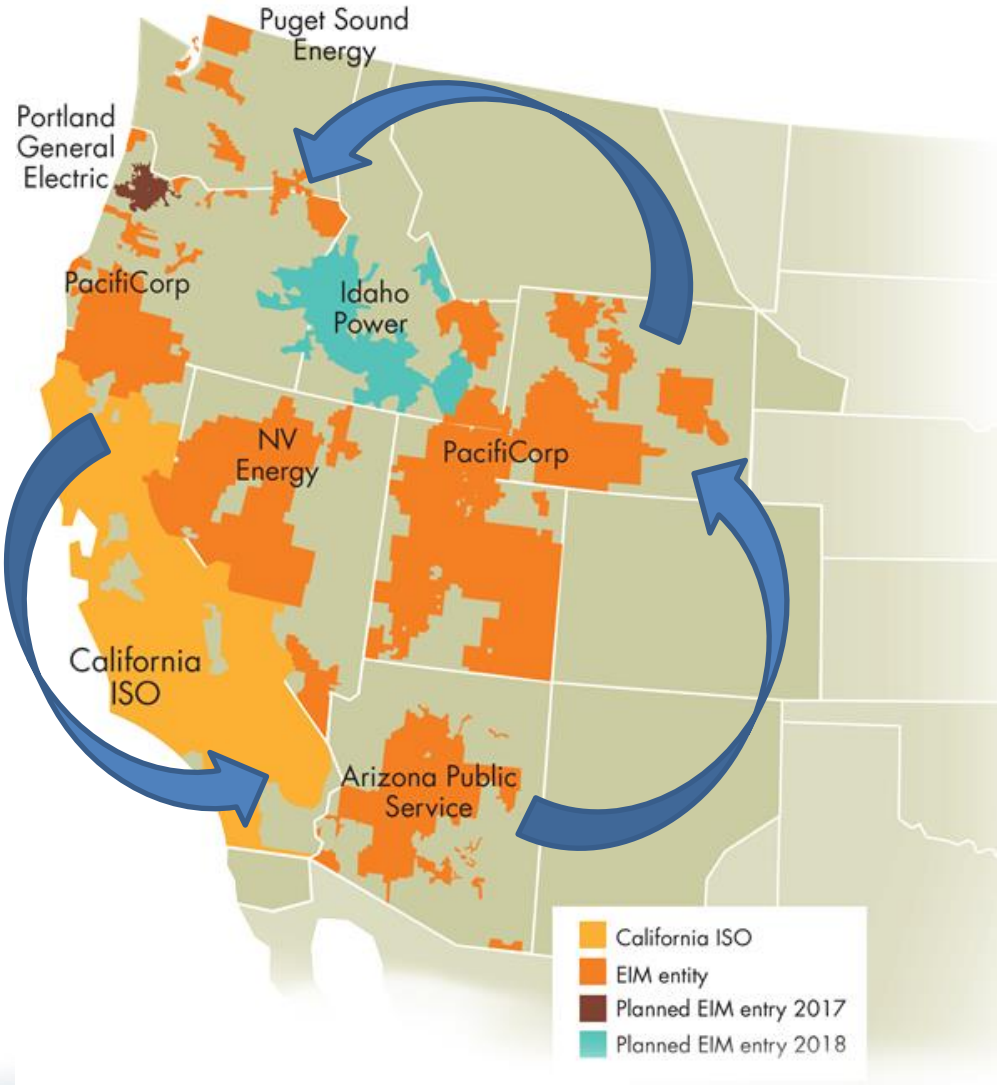
Renewable curtailment in 2024 at 40% RPS is significant



Solutions
Target energy efficiency
Increase storage and demand response
Enable economic dispatch of renewables
Decarbonize transportation fuels
Retrofit existing power plants
Align time-of-use rates with system conditions
Diversify resource portfolio
Deepen regional coordination

Western Energy Imbalance Market is proving out the benefits of a centralized regional market but is limited to just real-time

- Total savings of $114.35 million since start in Nov 2014
- 304,848 MWh curtailment avoided, displacing an estimated 136,724 metric tons of CO2
- Integration of renewables across a larger geographical area
- Enhances reliability with improved situational awareness
- Reduces costs through automatic economic dispatch
- Balancing authorities maintain control and reliability responsibilities



A regional ISO provides several benefits to the West

Direct economic benefits to customers

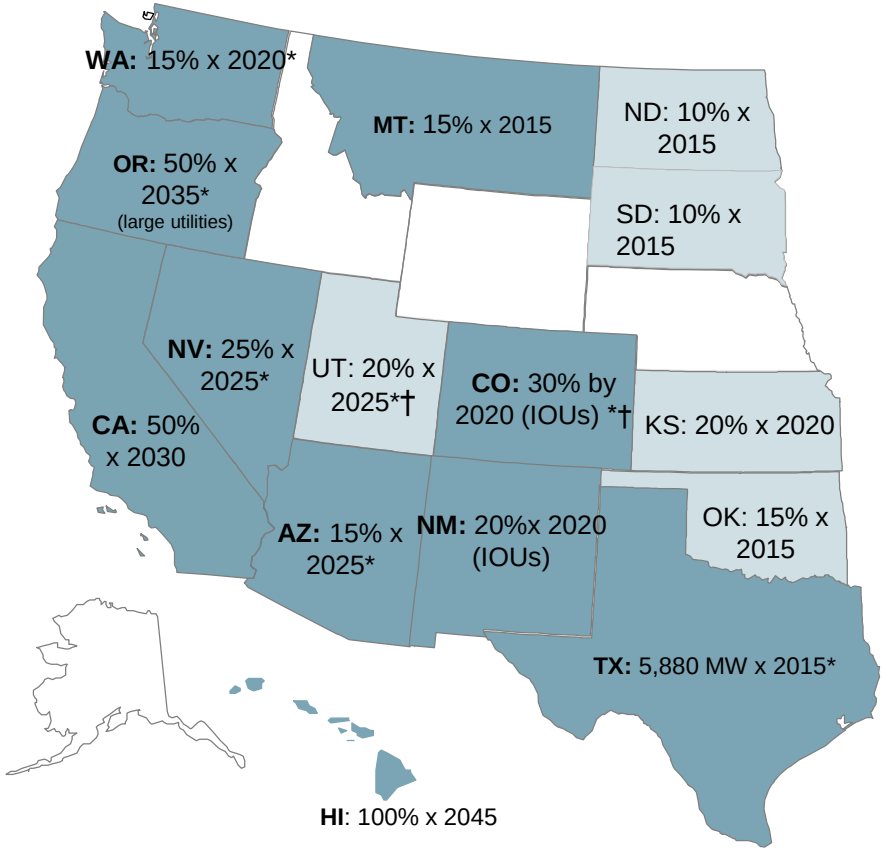
Efficient renewable integration

Reduced greenhouse gas emissions

Enhanced reliability through increased visibility

Western energy imbalance market is first step

Majority of western states have an RPS. A regional ISO can transform the electricity sector to a low-carbon energy delivery system



www.dsireusa.org / October 2015

Renewable portfolio standard

Renewable portfolio goal

* Extra credit for solar or customer-sited renewables

† Includes non-renewable alternative resources

Regional market integration can:

- ❑ Reduce customer costs
- ❑ Enhance coordination and reliability
- ❑ Facilitate renewable resource integration
- ❑ Reduce emissions
- ❑ Enhance regional system planning

Successful market integration requires:

- ❑ Change in California state statute to amend governance
- ❑ Approval by PacifiCorp state regulatory bodies and the FERC
- ❑ Approval by FERC on changes to PacifiCorp and ISO tariffs

Scope of the Studies required by SB350

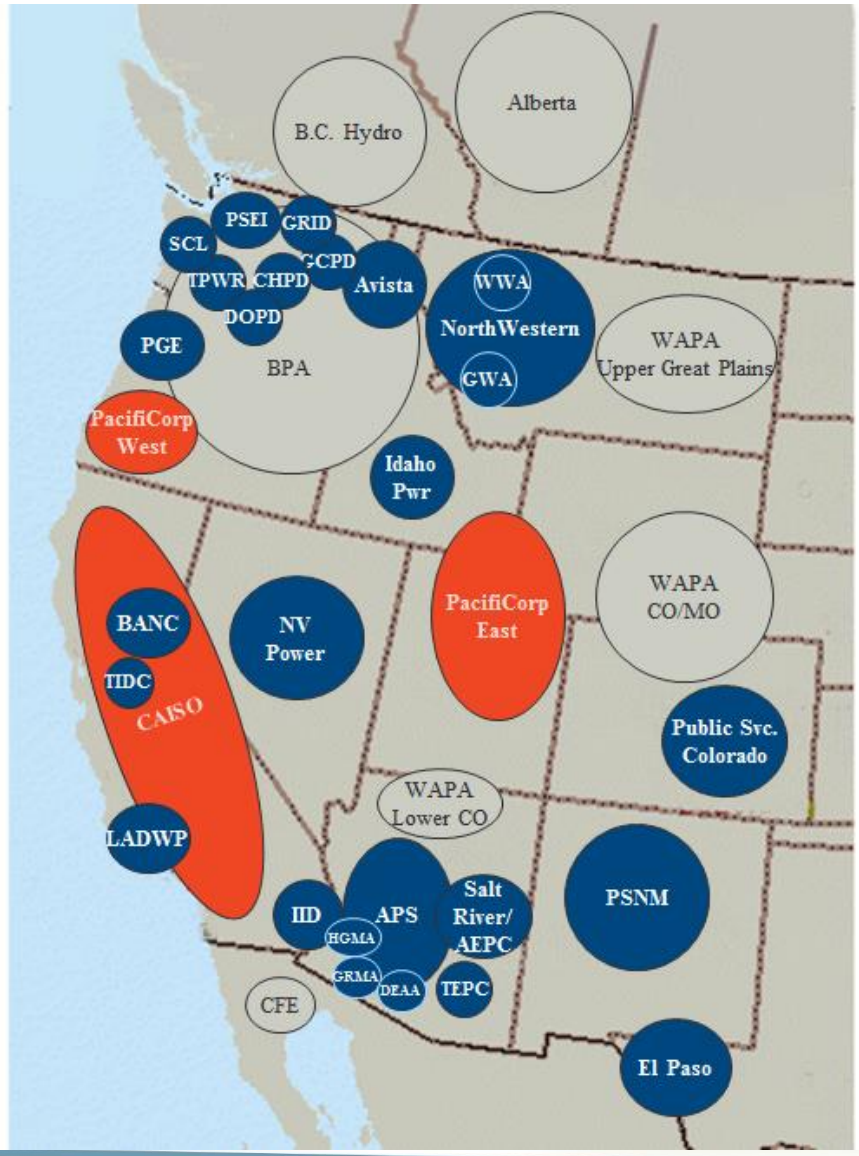
Legislative Requirement:

- 359.5. (a) It is the intent of the Legislature to provide for the transformation of the Independent System Operator into a regional organization…, and that the transformation should only occur where it is in the best interests of California and its ratepayers.

- The ISO will conduct studies of the impacts of a regional market, including:
  1. Overall benefits to **California ratepayers**
  2. Emissions of **greenhouse gases** and **other air pollutants**
  3. Creation or retention of **jobs** and other **benefits to the California economy**
  4. **Environmental** impacts in California and elsewhere
  5. Impacts in **disadvantaged communities**
  6. **Reliability** and **integration of renewable energy** resources

- The modeling, including all assumptions underlying the modeling, shall be made available for public review.

2020 and 2030 Hypothetical Regional Footprints



WECC currently consists of 38 individual Balancing Authorities

2020 Footprint: Regional ISO to consist of only CAISO and PacifiCorp: denoted as "**CAISO+PAC**"

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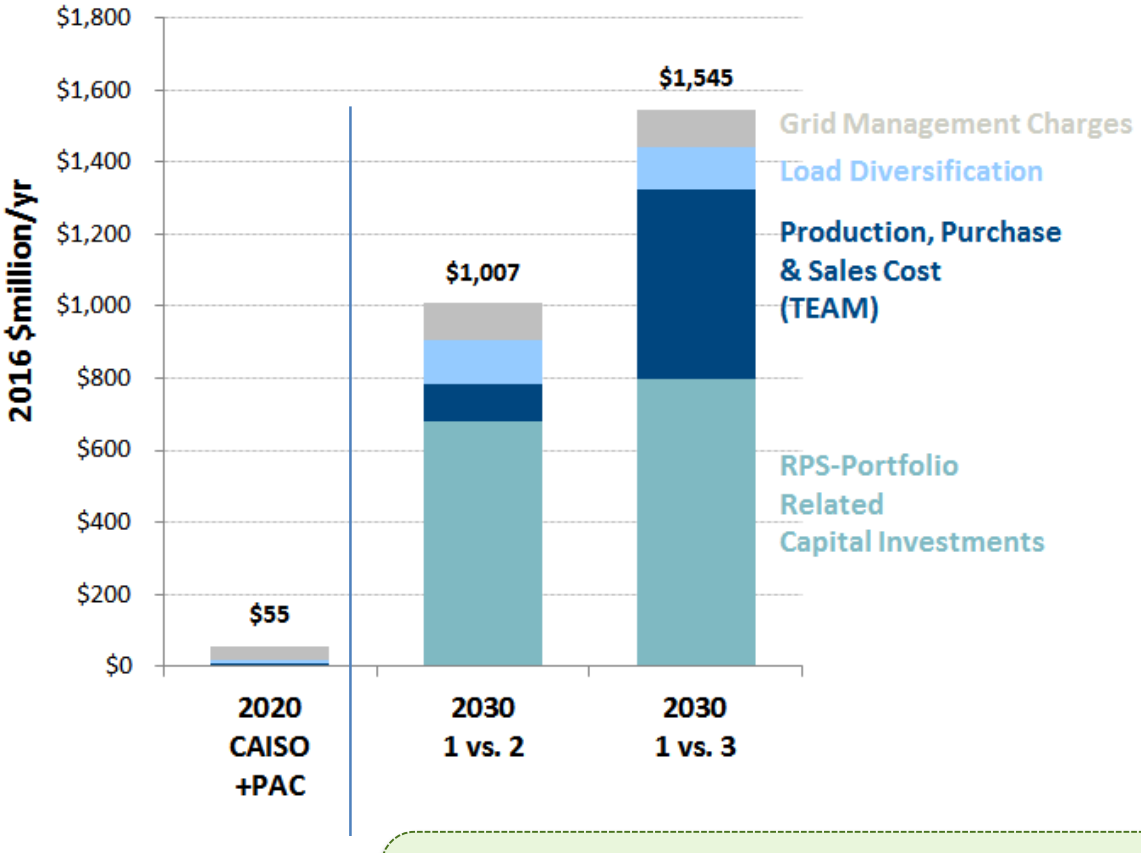
2030 Footprint: Expanded Regional ISO to consolidate all balancing areas in the U.S. WECC except the Federal Power Marketing Agencies (U.S. WECC w/o PMAs)

PMAs shown in the graphic as BPA, WAPA Upper Great Plains, WAPA CO/MO, WAPA Lower CO

Annual benefits to California ratepayers from expanded regional market

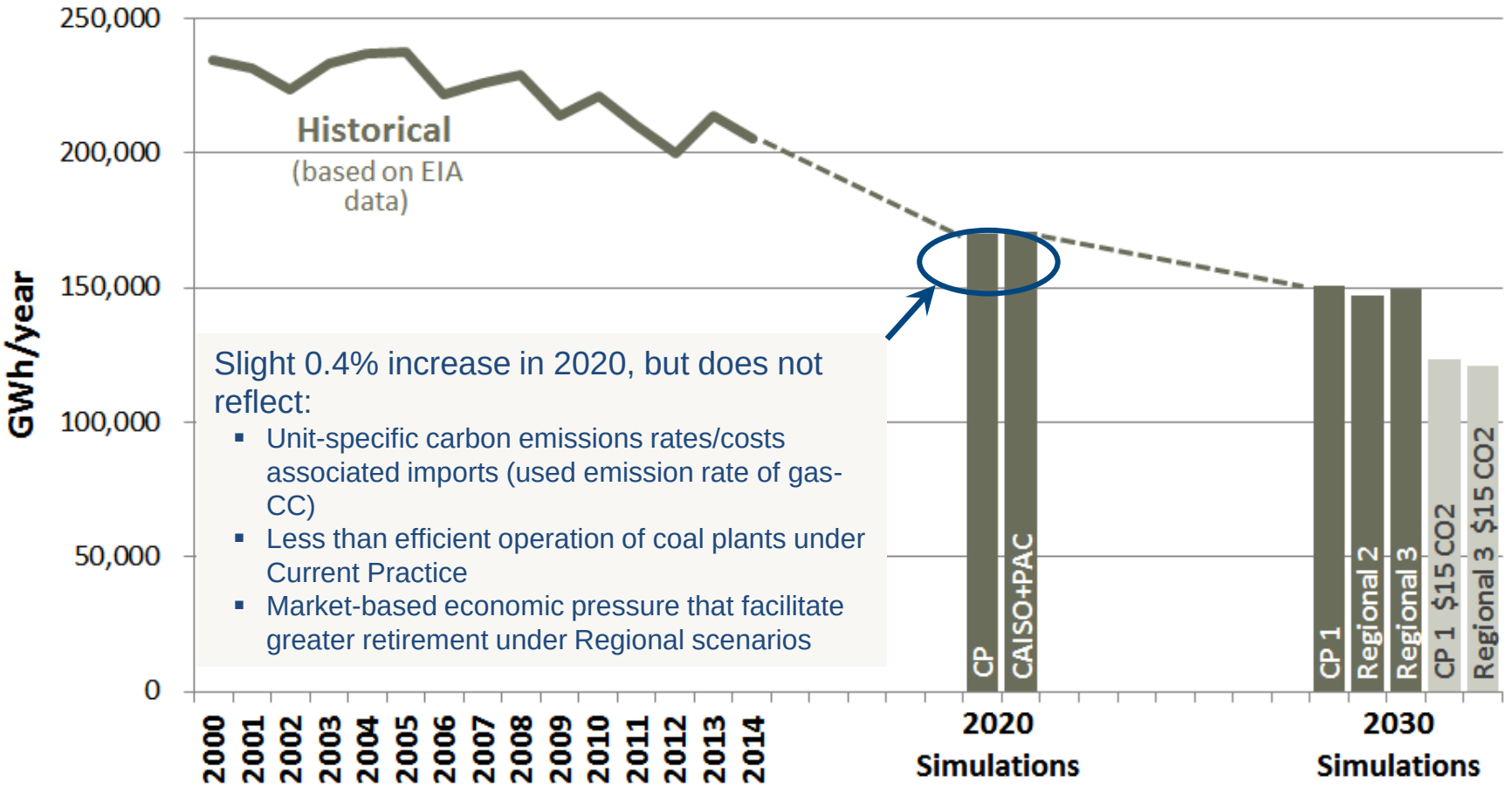


- California ratepayer impact analysis of an expanded regional market shows estimated savings:
  - **$55 million/year in 2020** (0.1% of retail rates) based on limited scope of CAISO-PAC region.
    - Would be $258 million/year for expanded regional footprint (WECC without PMAs)
  - **$1 billion to $1.5 billion/year in 2030** (2–3% of retail rates) depending on renewable procurement to meet 50% RPS

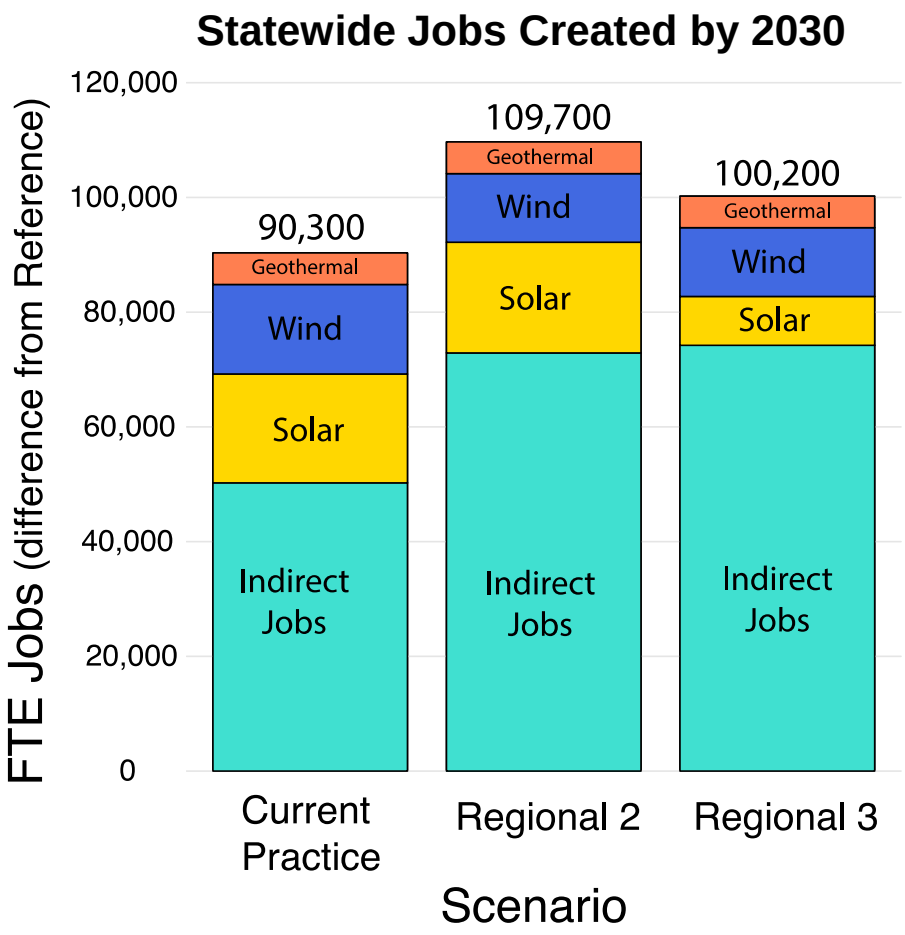
Overall benefits likely larger, consistent with findings of other studies
- Estimates based on conservative assumptions
- Value of additional regional market benefits was not quantified

Impact on Coal Dispatch in WECC

Simulated vs. Historical Coal-Fired Generation in the U.S. WECC

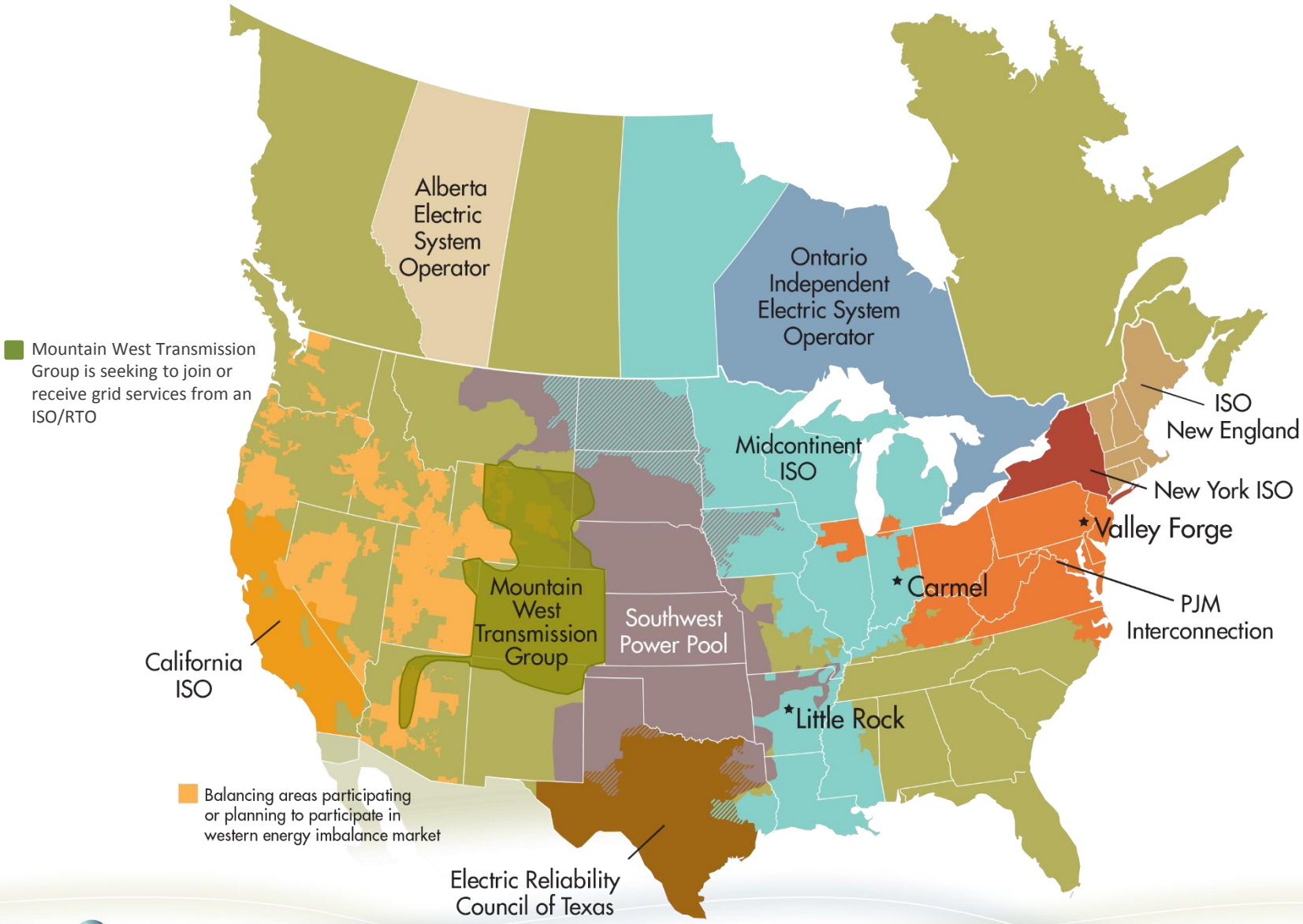


Regional market improves the California economy



- Regionalization (Scenarios 2 and 3) can create **9,900–19,400 more jobs** than Current Practice (Scenario 1A) in California, primarily by making electricity more affordable
  - Higher statewide household real disposable income due to more affordable energy
    - **$300–$550 more disposable income per household** in 2030 due to regional market
  - Higher statewide Gross State Product, real output, state revenue, and employment

A grid evolution is underway in the West



Regional ISO builds on EIM success and increases economic, environmental, and reliability benefits

Regional market integration efforts are aimed at

- reducing customer costs
- facilitating renewable energy resource integration
- reducing emissions
- enhancing coordination and reliability of western electric networks

Successful market integration will require changes in California state statute to amend governance

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THANK YOU